

Table J-58. Doses and radiological health impacts to involved workers from intermodal transfer station operations – Modules 1 and 2.^{a,b}

Group	Module 1		Module 2	
	Dose (millirem)	Latent cancer fatality	Dose (millirem)	Latent cancer fatality
Maximally exposed individual worker	12	0.005 ^c	12	0.005
Involved worker population	500	0.20 ^d	520	0.21

- a. Includes estimated impacts from handling 300 shipments of Naval spent nuclear fuel that would be shipped by rail under the mostly legal-weight truck transportation scenario.
- b. Totals for 38 years of operations.
- c. The estimated probability of a latent cancer fatality in an exposed individual.
- d. The estimated number of latent cancer fatalities in an exposed involved worker population.

Table J-59. Radiological and nonradiological health impacts from incident-free transportation for the heavy-haul truck implementing alternatives – Modules 1 and 2.^a

Category	Legal-weight truck shipments	Rail and heavy-haul truck shipments ^b	Total ^c
<i>Involved worker</i>			
Collective dose (person-rem)	110	2,100 - 3,100	2,200 - 3,300
Estimated latent cancer fatalities	0.04	0.85 - 1.3	0.89 - 1.3
<i>Public</i>			
Collective dose (person-rem)	19	100 - 580	120 - 600
Estimated latent cancer fatalities	0.01	0.05 - 0.29	0.06 - 0.3
<i>Estimated vehicle emission-related fatalities</i>	0.0046	0.0096 - 0.35	0.014 - 0.35

- a. Impacts are totals for 38 years.
- b. Includes impacts to workers at an intermodal transfer station.
- c. Totals might differ from sums due to rounding.

J.3.5 IMPACTS IN NEVADA FROM TRANSPORTATION ACCIDENTS FOR INVENTORY MODULES 1 AND 2

The analysis assumed that the routes, population densities, and shipment characteristics (for example, assumed radioactive material contents of shipping casks) for the Proposed Action and Inventory Modules 1 and 2 would be the same. The only difference would be the projected number of shipments that would travel to the repository. As listed in Table J-1, Module 2 would include about 3 percent more shipments than Module 1.

J.3.5.1 Mostly Legal-Weight Truck Scenario

Radiological Impacts

The analysis estimated the radiological impacts of accidents in Nevada for the mostly legal-weight truck scenario for shipments of the materials included in Inventory Modules 1 and 2. The radiological health impacts associated with both Modules 1 and 2 would be 0.1 person-rem (see Table J-60). These impacts would occur over 38 years in a population of more than 1 million people who lived within 80 kilometers (50 miles) of the Nevada routes that DOE would use. This dose risk would lead to less than 1 chance in 1,000 of an additional cancer fatality in the exposed population. For comparison, in Nevada about 240,000 in a population of 1 million people would suffer fatal cancers from other causes (DIRS 153066-Murphy 2000, p. 83).

Traffic Fatalities

The analysis estimated traffic fatalities from accidents involving the transport of spent nuclear fuel and high-level radioactive waste by legal-weight trucks in Nevada for the mostly legal-weight truck scenario for shipments of the materials included in Inventory Modules 1 and 2. It estimated that there would be

Table J-60. Accident impacts for Modules 1 and 2 – Nevada transportation.^a

Transportation scenario	Dose risk (person-rem)	Latent cancer fatalities	Traffic fatalities
<i>Legal-weight truck</i>	0.1 ^b	0.0001	0.97
<i>Legal-weight truck for the mostly rail scenario</i>	0.003	0.000001	0.03
<i>Mostly rail (Nevada rail implementing alternatives)</i>			
Caliente	0.0012	0.000001	0.12
Carlin	0.0026	0.000001	0.16
Caliente-Chalk Mountain	0.0011	0.000001	0.08
Jean	0.01	0.000005	0.09
Valley Modified	0.0017	0.000001	0.08
<i>Mostly rail (Nevada heavy-haul implementing alternatives)</i>			
Caliente	0.015	0.000008	1.2
Caliente/Chalk Mountain	0.002	0.000001	0.62
Caliente/Las Vegas	0.092	0.00005	0.83
Apex/Dry Lake	0.091	0.00005	0.44
Sloan/Jean	0.2	0.0001	0.46

a. Impacts over 38 years.

b. Estimates of dose risk are for the transportation of the materials included in Module 2. Estimates of dose risk for transportation of the materials in Module 1 would be slightly (about 3 percent) lower.

0.97 fatality over 38 years for Module 1 or Module 2 (see Table J-60). The estimate of traffic fatalities includes the risk of fatalities from 300 shipments of naval spent nuclear fuel.

J.3.5.2 Nevada Rail Implementing Alternatives

Industrial Safety Impacts

Table J-61 lists the estimated industrial safety impacts in Nevada for the operation of a branch rail line to ship the materials included in Inventory Modules 1 and 2. The table lists impacts that would result from operations for a branch line in each of the five possible rail corridors in Nevada that DOE is evaluating.

Table J-61. Rail corridor operation worker physical trauma impacts (Modules 1 and 2).

Worker group and impact category	Corridor				
	Caliente	Carlin	Caliente-Chalk Mountain	Jean	Valley Modified
<i>Involved workers</i>					
TRC ^a	150	150	150	115	115
LWC ^b	82	82	82	63	63
Fatalities	0.41	0.41	0.41	0.31	0.31
<i>Noninvolved workers^c</i>					
TRC	9	9	9	7	7
LWC	3	3	3	2	2
Fatalities	0.01	0.01	0.01	0.01	0.01
<i>All workers (totals)^d</i>					
TRC	160	160	160	120	120
LWC	85	85	85	65	65
Fatalities	0.42	0.42	0.42	0.32	0.32
Traffic fatalities ^e	1.1	1.1	1.1	0.83	0.83

a. TRC = total recordable cases (injury and illness).

b. LWC = lost workday cases.

c. Noninvolved worker impacts are based on 25 percent of the involved worker level of effort.

d. Totals might differ from sums due to rounding.

e. Fatalities from accidents during commutes to and from jobs for involved and noninvolved workers.

The representative workplace loss incidence rate for each impact parameter (as compiled by the Bureau of Labor Statistics) was used as a multiplier to convert the operations crew level of effort to expected industrial safety losses. The involved worker full-time equivalent multiples that DOE would assign to operate each rail corridor each year was estimated to be 36 to 47 full-time equivalents, depending on the corridor for the period of operations [scaled from cost data in DIRS 101214-CRWMS M&O (1996, Appendix E)]. Noninvolved worker full-time equivalent multiples were unavailable, so DOE assumed that the noninvolved worker level of effort would be similar to that for the repository operations work force—about 25 percent of that for involved workers. The Bureau of Labor Statistics loss incidence rate for each total recordable case, lost workday, and fatality trauma category (for example, the number of total recordable cases per full-time equivalent) was multiplied by the involved and noninvolved worker full-time equivalent multiples to project the associated trauma incidence.

The Bureau of Labor Statistics involved worker total recordable case incidence rate, 145,700 total recordable cases in a workforce of 1,739,000 workers (0.084 total recordable case per full-time equivalent) reflects losses in the Trucking and Warehousing sector during the 1998 period of record. The same Bureau of Labor Statistics period of record and industry sector was used to select the involved worker lost workday case incidence rate [80,000 lost workday cases in a workforce of 1,739,000 workers (0.046 lost workday case per full-time equivalent)]. The involved worker fatality incidence rate, 23.4 fatalities in a workforce of 100,000 workers (0.00023 fatality per full-time equivalent) reflects losses in the Transportation and Material Moving Occupations sector during the 1998 period of record.

The noninvolved worker total recordable case incidence rate of 61,000 total recordable cases in a workforce of 3,170,300 workers (0.019 total recordable case per full-time equivalent) reflects losses in the Engineering and Management Services sector during the Bureau of Labor Statistics 1998 period of record. DOE used the same period of record and industry sector to select the noninvolved worker lost workday case incidence rate [22,400 lost workday cases in a workforce of 3,170,300 workers (0.071 lost workday case per full-time equivalent)]. The noninvolved worker fatality incidence rate, 1.6 fatalities in a workforce of 100,000 workers (0.00002 fatality per full-time equivalent) reflects losses in the Managerial and Professional Specialties sector during the 1998 period of record.

Table J-61 lists the results of these industrial safety calculations for the five candidate corridors under Inventory Modules 1 and 2. The table also lists estimates of the number of traffic fatalities that would occur in the course of commuting by workers to and from their construction and operations jobs. These estimates used national statistics for average commute distances [18.5 kilometers (11.5 miles) one-way (DIRS 102064-FHWA 1999, all)] and fatality rates for automobile traffic [1 per 100 million kilometers (1.5 per 100 million miles) (DIRS 148080-BTS 1998, all)].

Radiological Impacts of Accidents

The analysis estimated the radiological impacts of accident scenarios in Nevada for the Nevada rail implementing alternatives for shipments of the materials included in Inventory Modules 1 and 2. Table J-60 lists the radiological dose risk and associated risk of latent cancer fatalities. The risks include accident risks in Nevada from approximately 3,100 legal-weight truck shipments from commercial sites that could not ship spent nuclear fuel in rail casks while operational. The analysis assumed that those sites would upgrade their crane capacity after reactor shutdown to allow the use of rail casks. The risks would occur over 38 years.

Traffic Fatalities

Traffic fatalities from accidents involving transport of spent nuclear fuel and high-level radioactive waste by rail in Nevada were estimated for the Nevada rail implementing alternatives for shipments of materials included in Inventory Modules 1 and 2. Table J-60 lists the estimated number of fatalities that would occur over 38 years for a branch rail line along each of the five candidate rail corridors. These estimates

include accident risks in Nevada from about 3,100 legal-weight truck shipments from commercial generators that could not ship spent nuclear fuel in rail casks while operational.

J.3.5.3 Nevada Heavy-Haul Truck Implementing Alternatives

Industrial Safety Impacts

Tables J-62 and J-63 list the estimated industrial safety impacts in Nevada for operations of heavy-haul trucks (principally highway maintenance safety impacts) and operation of an intermodal transfer station that would transfer loaded and unloaded rail casks between rail cars and heavy-haul trucks for shipments of the materials included in Inventory Modules 1 and 2. Table J-62 lists the estimated industrial safety impacts in Nevada for the operation of a heavy-haul route to the Yucca Mountain site. Table J-63 lists impacts that would result from the operation of an intermodal transfer station for any of the five candidate routes DOE is evaluating that heavy-haul trucks could use in Nevada.

Table J-62. Industrial health impacts from heavy-haul truck route operations (Modules 1 and 2).

Worker group and impact category	Corridor				
	Caliente	Caliente/Chalk Mountain	Caliente/Las Vegas	Sloan/Jean	Apex/Dry Lake
<i>Involved workers</i>					
TRC ^a	350	350	320	190	190
LWC ^b	190	190	180	100	100
Fatalities	1.0	1.0	0.9	0.5	0.5
<i>Noninvolved workers^c</i>					
TRC	20	20	18	11	11
LWC	8	8	7	4	4
Fatalities	0.02	0.02	0.02	0.01	0.01
<i>All workers (totals)^d</i>					
TRC	370	370	340	200	200
LWC	200	200	180	110	110
Fatalities	0.99	0.99	0.99	0.53	0.53
Traffic fatalities ^e	2.6	2.3	2.6	1.4	1.4

a. TRC = total recordable cases (injury and illness).

b. LWC = lost workday cases.

c. Noninvolved worker impacts are based on 25 percent of the involved worker level of effort.

d. Totals might differ from sums due to rounding.

e. Fatalities from accidents during commutes to and from jobs for involved and noninvolved workers.

Table J-63. Annual physical trauma impacts to workers from intermodal transfer station operations (Module 1 or 2).

Involved workers			Noninvolved workers ^a			All workers		
TRC ^b	LWC ^c	Fatalities	TRC	LWC	Fatalities	TRC	LWC	Fatalities
85	47	0.23	5	2	0.01	90	48	0.24

a. The noninvolved worker impacts are based on 25 percent of the involved worker level of effort.

b. TRC = total recordable cases of injury and illness.

c. LWC = lost workday cases.

Radiological Impacts of Accidents

The analysis estimated the radiological impacts of accidents in Nevada for the Nevada heavy-haul truck implementing alternatives for shipments of the materials included in Inventory Modules 1 and 2.

Table J-60 lists the radiological dose risk and associated risk of latent cancer fatalities. The risks include accident risks in Nevada from approximately 3,100 legal-weight truck shipments from commercial

generating sites that could not ship spent nuclear fuel in rail casks while operational. The risk would occur over 38 years.

Traffic Fatalities

The analysis estimated traffic fatalities from accidents involving the transport of spent nuclear fuel and high-level radioactive waste (including the rail portion of transportation to and from an intermodal transfer station) in Nevada for the heavy-haul truck implementing alternatives for shipments of the materials included in Inventory Modules 1 and 2. Table J-60 lists the estimated number of fatalities that would occur over 38 years for a branch rail line and for each of the five candidate routes for heavy-haul trucks. The estimate for traffic fatalities includes accident risk in Nevada from about 3,100 legal-weight truck shipments from commercial generators that could not ship spent nuclear fuel in rail casks while operational.

J.3.6 IMPACTS FROM TRANSPORTATION OF OTHER MATERIALS

Other types of transportation activities associated with the Proposed Action would involve shipments of materials other than the spent nuclear fuel and high-level radioactive waste discussed in previous sections. These activities would include the transportation of people (commuter transportation). This section evaluates occupational and public health and safety and air quality impacts from the shipment of:

- Construction materials, consumables, and personnel for repository construction and operation, including repository components (disposal containers, emplacement pallets, drip shields, and solar panels).
- Waste including low-level waste, construction and demolition debris, sanitary and industrial solid waste, and hazardous waste
- Office and laboratory supplies, mail, and laboratory samples

The analysis included potential impacts of transporting these materials for the flexible design, in which the repository would be open for 76 years after emplacement, and for several lower-temperature operating scenarios that would leave the repository open and ventilated for 125 to 300 years, a surface facility that would provide storage during a cooling period, and the use of derated waste packages. The analysis assumed that material would be shipped across the United States to Nevada by rail, but that DOE would not build a rail line to the proposed repository, because the larger number of truck shipments would lead to higher impacts than those for rail shipments, as discussed above. In addition, because the construction schedule for a new rail line would coincide with the schedule for the construction of repository facilities, trucks would deliver materials for repository construction.

Rail service would benefit the delivery of the 11,300 disposal containers from manufacturers. Two 33,000-kilogram (about 73,000-pound) disposal containers and their 700-kilogram (about 1,500-pound) lids (DIRS 155347-CRWMS M&O 1999, all) would be delivered on a railcar—a total of 5,650 railcar deliveries over the 24-year period of the Proposed Action (8,400 railcar deliveries if DOE used 17,000 derated waste packages). These containers would be delivered to the repository along with shipments of spent nuclear fuel and high-level radioactive waste or separately on supply trains along with shipments of materials and equipment.

Disposal container components that would weigh as much as 34 metric tons (37.5 tons) would be transported to Nevada by rail and transferred to overweight trucks for shipment to the repository site. Overweight truck shipments would move the 11,300 (or 17,000 if derated) containers from a railhead to the site. The State of Nevada routinely provides permits to motor carriers for overweight, overdimension